

THE IMPACT OF SHARE INDEX FUTURES TRADING ON THE VOLATILITY
AND LIQUIDITY OF THE UNDERLYING ASSETS ON THE JOHANNESBURG
STOCK EXCHANGE

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by

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I certify that, except as noted above, this work is entirely my own and has not been submitted as a dissertation for a degree at any other university.

Signed by candidate

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ABSTRACT

Empirical studies of the effect of futures markets on the volatility of the related spot markets have yielded conflicting results. Some studies have found that futures trading increases the volatility of the underlying assets and thus has a destabilising effect. Other research has found that futures trading reduces volatility. There are theoretical arguments to support both opposing views on the impact of futures trading on the volatility of the underlying assets. As volatility is used as a risk measure, it affects the value of investments.

It has been found that liquidity has a highly significant effect on share returns. Higher levels of liquidity mean that assets are more tradable. Investors are willing to pay premium for the ability to dispose of their investments at a high price and within a short period of time.

Both volatility and liquidity thus have an impact on the value of investments. The purpose of the study is to investigate what effect index futures trading has had on the liquidity and volatility of the underlying asset market on the Johannesburg Stock Exchange (JSE).

This study covers the period from 1990 to 1997 and investigates the relationship between the volume and value of index futures trading for the three main share indices and the volatility of the underlying assets on the JSE.

The results of the regression tests indicate significant positive relationships between futures trading activity and the volatility of the underlying assets for the All Gold Index and the Industrial Index. This suggests that increased futures trading is associated with increased volatility in the underlying assets. The relationships were not significant for the All Share Index. The results support the hypothesis that index futures trading increases the volatility of the underlying assets.

Regression tests were performed using the volume of trade in the constituents of the indices as a measure of the liquidity of the underlying assets. The results indicate significant relationships with both the volume and value of related futures trading for all three indices. There are thus significant positive relationship between the level of futures trading activity and the liquidity of the cash market.

Using the liquidity ratio as a measure of the liquidity of the underlying assets did not result in any significant relationships between the liquidity of the underlying assets and the level of futures trading.

These conflicting results highlight the problem associated with the measurement of liquidity. An increase in volume, all else being equal, does however improve the tradability and thus the liquidity of an asset. The results therefore support the hypothesis that index futures trading is associated with greater liquidity in the underlying assets.

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CHAPTER ONE

THE PROBLEM AND ITS SETTING

1.1 Introduction

In an article entitled "Calming the market" in the Washington Post of 25 July, 1988, Shad, a former chairperson of the Securities and Exchange Commission in the United States, writes that "While stock index futures serve valid arbitrage and hedging purposes, they have escalated the leverage and volatility of the entire stock market to unacceptable levels" (Bessembinder and Seguin, 1992). In another article, "Raise futures and options margins now" in the Wall Street Journal of 15 January 1991, Shad writes that the "multi-billions of dollars of transactions" on the derivative markets have "escalated the leverage and volatility of the markets to precipitous unacceptable levels" (Vanden Baviere and De Villiers, 1997).

Amid speculation of a repeat of the 17 October 1987 crash, an article entitled "JSE's volatility on the rise" appeared in the Cape Times Business Report of 9 October 1997. It quotes a local securities dealer who argues that "The volatility had a lot to do with the futures close out, particularly when it peaked in August. There was a lot of futures trading, and the big shares were being sold before the close-out... it was basically futures-manipulated".

The strong opinions reflected in these opening paragraphs have been subjected to empirical analysis. Empirical studies of the effect of futures markets on the volatility of the related spot markets have, however, yielded conflicting results (Figlewski, 1981; Edwards, Harris, 1989).

Amihud and Mendelson (1986) found that liquidity has a highly significant effect on share returns. The subject has received far less attention than volatility in the literature. Grossman (1988b) proposes that market makers in futures markets combine with market makers in the spot market

to enhance the overall liquidity of the equity market. Bessembinder and Seguin (1992) support Grossman's (1988a) theory of increased market liquidity as a result of futures trading.

The problem addressed in this paper is what impact share index futures trading has had on the volatility and the liquidity of the underlying assets on the Johannesburg Stock Exchange (JSE).

1.2 The South African Futures Exchange (SAFEX)

The first commodity futures trading started in South Africa in 1973 with the futures broking house called Holcom Futures (Levett, 1991). It took another thirteen years before another one was established.

The introduction of share index futures led to an increase in futures trading in South Africa. Trading in the three share index futures commenced on an over-the-counter basis in March and April of 1987. Futures trading on the All Share, All Gold and Industrial indices of the JSE was started by Rand Merchant Bank. Other market makers like Cape Investment Bank and National Discount house joined Rand Merchant Bank and in 1988 they founded the South African Futures Exchange (SAFEX, 1997).

The average daily turnover has increased from 2 000 contracts in 1990 to more than 40 000 contracts. The products include share index futures, bond and interest rate futures and commodity futures. There are four share index futures, the All Share (INDI40), All Gold (GLDI10), Industrial (INDI25) and the Financial and Industrial (FNDI30).

The major portion of the volume is in the JSE ALSI40, INDI25 and GLDI10 contracts (SAFEX, 1997). The details of the three major contracts are shown in the table on the following page.

Details of share index futures from the SAFEX web page:

Futures Contract	All Share Index	All Gold Index	Industrial Index
Code	ALSI	GLDI	INDI
Underlying Instrument	JSE Actuaries Top 40 Companies All Share Index	JSE Actuaries Top 10 Companies Gold Index	JSE Actuaries Top 25 Companies Industrial Index
Contract Size	R10 x Index Level	R10 x Index Level	R10 x Index Level
Expiry Dates & times	12h00 on 3 rd Friday of Mar, Jun, Sep & Dec (or previous business day)	12h00 on 3 rd Friday of Mar, Jun, Sep & Dec (or previous business day)	12h00 on 3 rd Friday of Mar, Jun, Sep & Dec (or previous business day)
Quotations	Index level (no decimal points)	Index level (no decimal points)	Index level (no decimal points)
Minimum Price Movement	One index point (R10)	One index point (R10)	One index point (R10)
Initial Margin	Approximately R3,500 (revised periodically by Risk Committee) Reduced margin for spread positions	Approximately R3,500 (revised periodically by Risk Committee) Reduced margin for spread positions	Approximately R3,500 (revised periodically by Risk Committee) Reduced margin for spread positions
Expiry valuation method	Arithmetic average of index taken every two minutes, over the final two hours of trading on expiry date, as calculated by the JSE	Arithmetic average of index taken every two minutes, over the final two hours of trading on expiry date, as calculated by the JSE	Arithmetic average of index taken every two minutes, over the final two hours of trading on expiry date, as calculated by the JSE
Settlement Method	Cash Settled	Cash Settled	Cash Settled
Clearing House fees	R1.70 per contract Options R0.70 per contract	R1.70 per contract Options R0.70 per contract	R1.70 per contract Options R0.70 per contract

1.3 Objective of the study

The purpose of the study is to investigate what effect index futures trading has had on the liquidity and volatility of the underlying asset market on the JSE.

1.4 The assumptions

The behaviour of the index levels of the ALSI, ALSI40, INDI, INDI25, GLDI and GLDI10 on the SAFEX is assumed to be representative of the behaviour of the prices of the underlying assets of the entire JSE, the industrial sector and the gold sector.

The behaviour of the aggregate trading volumes of the constituents of the ALSI40, GLDI10 and INDI25 is assumed to be representative of the behaviour of the trading volumes of the entire exchange, the gold sector and the industrial sector.

1.5 The delimitations of the study

The study deals only with the relationship between the SAFEX and the JSE. It also deals only with share index futures trading and not with the other financial and commodity futures traded on the SAFEX.

The study investigates the All Share Index futures, the All Gold Index futures and the Industrial Index futures as this is where the majority of the trading activity has occurred (SAFEX, 1997). It does not deal with the Financial and Industrial Index futures.

1.6 The organisation of the remainder of the study

Chapter Two contains a review of the related literature on the nature of volatility, the nature of liquidity, the theories of the impact of index futures trading and the results of the related empirical research. Chapter Three contains the research method and Chapter Four describes the data used in the study. Chapter Five details the results of the empirical research, and the conclusions are contained in Chapter Six.

University of Cape Town

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Volatility and liquidity are closely related and much of the literature deals with both together. The review has been divided loosely into the following headings which cover the major issues highlighted by the literature:

2.2 The nature of volatility

2.3 A theoretical perspective of the impact of futures trading on the volatility of the underlying assets

2.4 Empirical research: The impact of futures trading on the volatility of the underlying assets

2.5 The nature of liquidity

2.6 A theoretical perspective of the impact of futures trading on the liquidity of the underlying assets

2.2 The nature of volatility

The following papers discuss the nature and some of the causes of volatility. They form the basis for the discussion of the impact of futures trading on the volatility of the underlying assets.

Karpoff (1987) reviews research on the relationship between trading volumes and price changes in financial markets. He regards the price-volume relationship as having significant implications for research into futures markets.

Karpoff states that price variability affects the volume of trade in futures contracts. This is relevant to the issue of whether speculation has a stabilising or destabilising effect on futures prices. The time to delivery of a futures contract affects the volume of trading, and through this effect, possibly also the variability of the price of the contract.

He finds that volume is positively related to the magnitude of price changes. In equity markets there is also a positive relationship between volume and the prices of equities. This supports some of the findings in the papers on liquidity.

Schwert (1989) extends the scope of Karpoff and investigates other factors related to volatility. He finds that changes in the level of market volatility can have important effects on capital investment, consumption and other business cycle variables.

He finds weak evidence that macro-economic volatility can help to predict share and bond return volatility. The evidence is stronger that financial asset volatility helps to predict future macro-economic volatility. He does not find this surprising as the prices of speculative assets should react quickly to new information about economic events.

Financial leverage affects share price volatility. When share prices fall relative to bond prices, or when firms issue new debt securities in a larger proportion to new equity than in their prior capital structure, share volatility increases. However, this effect explains only a small proportion of the changes in share price volatility over time.

He finds what seems to be a relationship between trading activity and share volatility. The number of trading days in the month is positively related to the share price volatility. Also, share trading volume growth is positively related to share volatility.

Schwert thus finds a number of factors which are related to volatility. None of the factors however play a dominant role in explaining the behaviour of share price volatility over time.

Volatility tests have been viewed as tests of market efficiency (Cochrane, 1991). Ackert and Smith (1993) investigate discrepancies between earlier studies of share price volatility and the efficient markets model. Variance-bound tests are conducted in an attempt to explain share price volatility as being caused by variations in expected cash dividend returns.

Ackert and Smith show that volatility, as a measure of market efficiency, using the variance-bound tests, depends on the definition of dividends. Using the narrow definition of cash dividend returns, they reject the efficient markets model. They re-perform their tests on the basis that share prices should reflect the discounted value of all anticipated future cash flows. These include cash distributions resulting from share re-purchases and take-overs.

They find that investors receive their returns from a steady stream of cash dividends and a more volatile stream of other inflows. The volatility of the share prices are not too high to be explained by the discounted values of the total cash flows. The share prices are thus found to be set by rational investors as the present values of all anticipated future cash flows, and the efficient markets model cannot be rejected.

Negative attitudes towards volatility have resulted in regulatory controls in an attempt to reduce volatility. Subrahmanyam (1994) investigates the introduction of "circuit breakers" by the New York Stock Exchange (NYSE). Trading halts were imposed for a certain period of time if the Dow Jones Industrial Average moved by more than a certain amount over the previous day's close. The study addresses the effect of trading halts on the ex ante trading decisions of market participants and thus on the market liquidity and price variability.

The paper shows that circuit breakers can, by encouraging traders to make sub-optimal advance trades in time, increase

price variability and exacerbate price movements. Where traders move from a primary market to satellite market, price variability and market liquidity decline in the primary market and increase in the satellite market. Lee, Ready and Seguin (1994) also found that trading halts increase rather than reduce both volume and volatility.

These studies add weight to the efficient markets hypothesis. The volatility of share prices is found to be a rational response to information available to investors. Attempts to reduce volatility by imposing trading halts lead to reduced efficiency in the market and to even higher levels of volatility. Volatility is found to be related to a number of different factors and no individual factor was found to dominate the explanatory power of the level of volatility.

2.3 A theoretical perspective of the impact of futures trading on the volatility of the underlying assets

The effect of futures trading on commodity prices has been a controversial subject for a long time (Cox, 1976). For about eighty years many farmers, regulators and economists have claimed that futures trading destabilises the spot prices and causes losses for consumers and producers (Forsythe, Palfrey and Plott, 1984). This led to regulation in the United States of the futures markets. The trade in onion futures was prohibited in 1958 and futures trading in all other commodities was regulated by the Commodity Futures Trading Commission (Cox, 1976).

According to Cox, the congressional hearings on the regulation of the futures markets showed that the regulators had neither a theory nor empirical evidence to support their theory of destabilisation caused by futures trading. He finds that several studies have yielded conflicting results with some finding no effect and others finding both increases and decreases in volatility as a result of futures trading.

Danthine (1978) supports a multi-role theory of futures markets. Futures prices have an informative role where they are used as statistics by rational traders who use them in formulating their probability distributions. Danthine argues that together with the role of futures prices on commodity supply decisions, this informative view of futures trading implies a stabilising influence of speculation on spot prices.

The futures markets are also a place where hedgers compensate speculators for sharing risks inherent to their productive activity. The asymmetry between traders, some of whom have real commitments and others who do not, reveals the futures price as a biased estimate of the spot price which, in its own right, can generate speculative trading.

Figlewski's paper (1981) on futures trading and volatility in the Government National Mortgage Association (GNMA) was written as futures markets were expanding from commodities to financial futures in the United States. He notes that the introduction of exchange traded futures contracts for treasury bills, GNMA pass-through certificates and other securities created new hedging, arbitrage and speculative opportunities for investors. He holds that futures trading opened these markets to new types of traders such as the private and smaller institutions.

Figlewski argues that through the process of arbitrage, a financial futures market will be closely related to the underlying spot market. He points out several ways in which futures trading could increase efficiency and smooth price variations in the cash market:

The most important role of futures markets is to provide traders in the underlying assets with a hedging mechanism to protect themselves against unfavourable price changes. Futures markets help to spread risk and transfer it from hedgers of spot positions to speculators who have higher risk profiles. He argues that the risk transfer may improve the

functioning of the spot market by reducing the need to incorporate a risk premium for price fluctuations into the cash prices of the underlying assets.

The introduction of futures trading may also increase the informational efficiency of the cash market. Futures markets are expected to be informationally efficient and incorporate the best estimates of future prices. Through the arbitrage process, this information will impact on the prices in the underlying assets. The magnitude of these effects will depend on the nature of the underlying asset market. A highly efficient cash market will clearly not be as affected by greater informational efficiency in the futures market as would an inefficient market.

Figlewski also states that it is possible that in some cases futures trading could increase cash price variability. When futures prices are distorted by technical factors or manipulation, then mis-pricing could spread to the cash market. He believes that these problems could be solved effectively by introducing suitable regulation.

Futures markets may also lead to a significant volume of hedge trading without sufficient speculative trade to allow for effective risk transfer. This could result in the dealers and market makers having to bear risk transferred through both the cash and the futures markets.

If the investors in the cash market have better information than those in the futures market, then their trading could drive the cash prices away from their most appropriate values. This will induce trading by the better informed cash market traders to stabilise the futures prices and will lead to more volatility in the cash prices.

Forsythe, Palfrey and Plott (1984) discuss the popular view that the futures market is only a socially acceptable form of gambling. This view holds that because futures markets are speculative, spot markets are more volatile with futures

markets than without them. The theory predicts that futures markets lead to inefficiencies in the underlying asset markets by causing sub-optimal allocations of resources. They present the other side of the argument that futures markets publicise private information held in an economy. This allows the markets to reach equilibrium more easily and the resulting allocation of resources will be more efficient than if there was no futures trading.

The crash of October 1987 led to an increased interest in the volatility of the markets (Grossman, 1988b; Edwards 1988; Tosini, 1988; Hill and Jones, 1988). The public, still reeling under the shock of the crash was clearly demanding explanations.

Edwards (1988) argues that whenever high market volatility occurs, there is a tendency to blame it on any new innovations at the time. It is not therefore unexpected that index futures have been accused of increasing the volatility of cash prices. He acknowledges that expiration day volatility does occur when traders, who hold cash positions related to futures positions, unwind their positions at the end of the futures or option contracts. When the trades at the expiration dates occur mainly on one side of the market, they lead to an order imbalance in the cash market. If the specialists who handle the underlying shares cannot provide sufficient liquidity, then sharp upward or downward price movements will occur. On non-expiration days, portfolio insurance trading, in combination with programme trading, may cause unusual share price volatility.

Edwards addresses the question of why increased volatility should matter. It has been argued that higher volatility raises the risk premium demanded by investors, thereby raising real interest rates and the cost of capital. He believes that the theory and evidence to support this argument are questionable and that its social welfare implications are unclear.

He presents a simpler explanation for the concern over volatility. Investors are concerned about the present and future values of their investments and higher volatility leads to a perception of greater risk which affects the value of the investments. When there are large falls in the market, investors see the value of their assets decline. The fact that this is merely a redistribution of wealth with no social cost to the price change does not soften the effect. When asset prices show significant volatility over very short periods, investors begin to lose confidence in the market. They begin to see the market as a place for speculators and insiders and not for rational long-term investors. If this becomes a universal view then these investors will reduce their investment in the market.

Edwards finds it difficult to justify the public perception that increases in volatility are bad by linking volatility to economic welfare or economic activity. An increase in volatility may be a result of a change in economic factors, new information about them, or market expectations of changes in them. There is then no clear social cost to such volatility and it may even increase the efficient allocation of resources by enabling prices to reflect new information more quickly and accurately.

If volatility is lesser or greater than the level resulting from fundamental economic indicators, then the result will be mispricing and therefore a misallocation of resources. The volatility resulting from index futures trading should therefore only be criticised for causing excessive or deficient volatility. The social costs of short term excess volatility are likely to be minimal. The important issue is then whether index futures trading causes long-run excess volatility.

Edwards suggests that futures trading should bring more traders to the cash market, making the cash markets more liquid and therefore less volatile.

The belief, that share index futures trading increases volatility in the underlying markets, arises from the view that the establishment of futures markets attracts uninformed and irrational speculators who then trade in the futures and spot markets. Economists have concluded that it would take a considerable number of speculators to destabilise the spot markets. Nevertheless, the perception persists that futures prices are more volatile than spot prices and that this volatility is transmitted to the underlying assets by arbitrageurs (Edwards, 1988).

Share price volatility continued to receive much attention in the press after the 1987 crash (Harris, 1989). Many argued that the start of trade in index futures and index options increased speculative activity and that this destabilised the cash markets, leading to higher volatility. Harris agrees that the large volume of trading activity made the accusations seem plausible.

Grossman (1988a) discusses the effect of index arbitrage, using index futures, on the volatility of the underlying assets. He regards index arbitrageurs as messengers who take orders from the futures market and bring them to the stock market. Grossman presents his argument with the aid of a scenario in which there is a desire by institutions to sell shares in a company at a certain price. If there were no futures market, or index arbitrageurs, then institutions would sell the shares directly on the stock market, instead of trying to eliminate the downside risk by selling the shares on the futures market. The immediate selling pressure would have to be borne totally by the stock exchange market makers.

The market makers on the futures market and the stock market combine to increase the overall liquidity of the equity market. The index arbitrageurs take positions that help to unify the two markets.

According to Grossman, the portfolio insurance strategies used by institutions will increase share price volatility to some extent, even if there were no futures markets. Futures trading, however, facilitates low transaction cost trades in packages of shares. This allows institutions to trade more gradually than if there were no futures market. Larger transaction costs will encourage fewer but larger individual trades. Futures markets therefore cushion the effects of portfolio insurance by lowering transaction costs.

Hill and Jones (1988) hold that portfolio insurance in its most common form is implemented with index futures. It will have a cost that depends on the assumed volatility over the time horizon. Its realised cost will depend on the actual volatility over the period that the programme is in place.

Portfolio insurance programmes are implemented via dynamic hedging trade, in shares or share index futures, in varying amounts, in an attempt to duplicate the gains and losses that would have been achieved by holding a hypothetical put option with the desired terms. The trades associated with dynamic hedging are on the same side as the direction of the market, that is, selling when indices are falling, and buying when indices are rising. They thus tend to be destabilising and can contribute to higher market volatility.

Miller (1992) analyses the financial innovations of the previous two decades. In a section entitled "The Case Against the Innovations" he discusses the major criticisms levelled at the introduction of futures and options.

The new financial instruments have been blamed for lowering transaction costs and leading to too much short-term trading which wastes resources and reduces the planning horizons of firms and investors. While acknowledging that trading volumes have increased, Miller disputes the belief that financial innovations are the major cause. He also argues that increased trading does not necessarily mean more waste from society's point of view.

In recent years, stock market volatility has been rising and share index futures have been held responsible. The evidence fails to support the perception of rising volatility.

Volatility has not risen substantially during the last few decades, except around major crashes like that of October 1987. The tendency of volatility to rise after crashes and fall during booms has been a well researched and documented property of volatility series. The lack of evidence, to support the belief that volatility has been rising, suggests that the public may be using market crashes themselves as their definition of volatility. In order to assess whether or not the suspicions are true, given this definition, one needs to establish whether or not index futures and options were responsible crashes like that of October 1987.

The two most criticised applications of futures and options are portfolio insurance and index arbitrage. The former has been found to have been a contributing factor, but not of having caused the crash. Certain futures hedging strategies can lead to destabilisation of the market by concealing bearish views and creating arbitrage opportunities. Index arbitrage is generally regarded as being neutral in its impact on the market. The downward pressure in one market, caused by selling, is normally balanced by equal buying pressure in the other.

There are circumstances which could lead to an increase in volatility. Studies have found that prices are moved by news and not by speculative noise coming from the futures markets. The relatively low cost of futures trading makes it an easy entry point for any new information about the economy. If the news is significant enough to push prices through the arbitrage limits, then it will carry from the futures market to the cash market. Arbitrage is nevertheless the medium and not the message.

Stoll and Whaley (1997) respond to accusations of destabilisation by stating that investigations have shown

consistently that that index futures do not destabilise the underlying stock markets. Index futures have been found rather to increase liquidity and efficiency.

There are thus conflicting views on the effects of index futures trading on the volatility of the underlying assets. There are arguments to support both views that futures trading has a stabilising and a destabilising effect on underlying assets prices. Proponents of the destabilisation view have imposed regulations on futures markets in an attempt to control the effects on the underlying assets. Their detractors argue that the very measures they have imposed do more harm than good. The actual effect of futures trading is an empirical issue which has been investigated in the papers in the following section.

2.4 Empirical research: The impact of futures trading on the volatility of the underlying assets

Early research on the effect of futures trading on cash markets focuses on commodity futures markets (Cox, 1976; Danthine, 1978). Futures trading on interest-bearing securities and foreign currencies began in the early eighties (Figlewski, 1981). Index futures and options were introduced in the United States in 1982 and 1983 (Harris, 1989).

Cox (1976) investigates the effect of organised futures trading on information in the underlying spot markets. He studies the price effects of futures trading for onions, potatoes, pork bellies, hogs, cattle and frozen concentrated orange juice (FCOJ). For each commodity he compared the price behaviour in a period with no futures trading to the price behaviour in a period in which there was formal futures trading.

He concludes that:

1. Futures trading in a commodity increased the quantity of the traders' information.
2. A spot market is more efficient when there is futures trading in the sense that prices reflect available market information more fully.
3. The behaviour of prices does not support the claim that producers and consumers are harmed by price effects of futures trading.

The empirical evidence on price behaviour shows an information effect of futures trading. Market prices provide more accurate signals for resource allocation when there is futures trading in the commodity. The price effects result mainly from more fully informed traders.

The results are inconsistent with the view that futures trading destabilises spot prices in a way that is harmful to traders in the physical commodity. This has implications for regulatory policy because it contradicts the arguments supporting the prohibition of certain futures trading and regulation of futures in other commodities. The data does not support the claim that price effects impose costs on consumers and producers. Spot markets seem to work more efficiently because of futures trading and its prohibition reduces market efficiency.

Figlewski (1981) draws a conflicting conclusion on the effect of futures trading on the volatility of the underlying assets. He finds that price volatility in the GNMA cash market was related to several factors. Increased liquidity and lower average prices tended to stabilise the market while futures market activity increased the volatility of prices.

He finds no evidence of insufficient speculative activity in futures relative to hedging and ruled out the likelihood of price manipulation because of extensive safeguards against it. He holds that futures prices are set largely by the actions of a new class of traders with a lower quality of

information than the GNMA dealers who set the cash prices. When the additional noise in the futures market is transmitted to the cash market then volatility increases. He speculates that the effect of information differences may diminish as the futures traders gain more experience, but they are unlikely ever to have as complete information as the cash market dealers.

Figlewski argues that while the increased volatility may be undesirable, the futures market has extended the possibilities for hedging and risk management to a much wider investor population.

These papers examine the effects of futures trading on commodity and financial asset markets. Edwards (1988) extends the research to share index futures. He examines the volatility of the NYSE before and after the start of index futures trading. He finds no evidence that futures trading has caused long-run destabilisation of the stock market. Volatility appears to have dropped since the introduction of index futures trading.

Harris (1989) compares the cash price volatilities before and after the introduction derivative trading. He also performs a cross-sectional analysis comparing the volatility of the underlying assets to that of similar assets for which there is no derivative trade. He compares the volatility of a sample of S&P500 shares to that of a sample of non-S&P500 shares.

The results show an increase in the volatility of the S&P500 shares relative to the non-S&P500 shares. The increase started becoming significant in 1985 and is largest in volatilities measured from short return intervals. Harris found the differences to be statistically significant but probably too small to be of economic significance. He suggests that the increase could however be attributable to other factors.

Bessembinder and Seguin (1992) examine whether greater futures trading activity, volume and open interest, is associated with greater equity volatility. They find that equity volatility is negatively related to anticipated futures trading volume and anticipated open interest. This suggests that active futures markets lead to a decrease and not an increase in the volatility of the underlying equity market. This is consistent with theories (e.g. Grossman, 1988a) which predict that futures trading increases the liquidity and depth of the underlying asset market.

The study also investigates the hypothesis, originally suggested by Samuelson in 1965, that price volatility increases as the futures contract maturity date approaches. Futures trading activity varies throughout the contract period with systematic increases in the volume and the open interest towards the end of the contract period. Bessembinder and Seguin found that equity volatility is slightly higher on the expiration date but that it is not related to the futures cycle as a whole.

The study found a positive relationship between equity volatility and contemporaneous trading volumes in the spot equity and equity futures markets. The results were not considered to be definitive as the effect of environmental changes was not controlled for, nor could they study the behaviour of the market in the absence of futures trading.

They found no support for the theory that futures trading leads to price destabilisation of the equity markets. This is consistent with the theories of Grossman (1988b), Grossman and Miller (1988) and the findings of Edwards (1988).

A study of share volatility after the introduction of index futures on the JSE (Vanden Baviere and De Villiers, 1997) found no statistically significant increasing trend in the volatility of the index constituents relative to that of non-constituents.

Vanden Baviere and De Villiers finding, that the introduction of index futures trading did not increase the volatility of the index constituents, is consistent with the findings in the United States of Edwards (1988) and Bessembinder and Seguin (1992). Vanden Baviere and De Villiers' study investigates whether or not the volatility of the ALSI constituents has increased over the period from January 1988 to December 1994. The study does not attempt to find any link between futures trading activity and the volatility of the JSE.

The empirical evidence on the impact of index futures trading on the volatility of the underlying assets is therefore inconclusive. The conflicting results of certain studies (Figlewski, 1981; Edwards 1988), inconclusive results (Harris, 1989) and the conflicting theories (e.g. Forsythe, Palfrey and Plott, 1984) indicate that the discussion and speculation on the issue is by no means over.

2.5 The nature of liquidity

While the concept of liquidity is well understood, it is not a readily measurable property of assets (Grossman and Miller, 1988; De Villiers, 1996).

Grossman and Miller (1988) set out to develop a model of market structure that explains the nature of market liquidity. Liquidity is determined by the supply and demand of immediacy. Immediacy is the ability to trade without delay as soon as one party to a transaction has decided to dispose of, or purchase an asset. The demand for immediacy is affected by the volatility of the price of the asset and the ease with which the price risk can be diversified. The supply of immediacy is provided by market makers and is determined by the costs to the market maker of supplying the liquidity. They include the direct costs of carrying out the transaction and the opportunity cost associated with maintaining a level of liquidity sufficient to allow the market makers to remain open for business.

Grossman and Miller criticise the traditional bid-ask spread as a measure of liquidity. They state that the bid-ask spread is only an exact measure of the market maker's return for providing immediacy when the market maker simultaneously executes both sides of a trade, the one at the bid price, and the other at the ask price. In this situation the market maker only incurs the cost of carrying out the transaction as no liquidity service is provided. The spread does not therefore measure the cost of the supply of immediacy.

A large volume of transactions occur within the limits of the bid-ask spread. Individual traders may decide not to buy or sell at the quoted prices so that the quoted bid-ask spread is not an accurate reflection of the underlying market.

A third problem with the bid-ask spread measure exists when there is a delay between the orders to buy and sell. During this period the market makers are exposed to the risk of informationless trading. The spread will therefore include a component to compensate them for potential losses to more informed traders.

The authors also discuss the limitations of the liquidity ratio as a measure of market liquidity. The ratio is defined as the ratio of the average volume of trading to the average price change during a period of time. If the ratio is high then a high volume of trading leads to a small price change and a low value means that a low volume could induce a large price change. The ratio does not explain how an unusually large order would affect the price. It also does not differentiate between the many causes of volatility sufficiently. A market may be volatile because it is illiquid but still informationally efficient. Even when volumes of trading are low, price volatility can be high where the information is unambiguous.

The measurement of liquidity using the bid-ask spread is often complicated by a lack of available data. Roll (1984)

derives an implicit measure of the bid-ask spread from a time series of market prices. The bid-ask spread, regarded by Roll as a trading cost, is a measure of the liquidity of an asset. The method requires two major assumptions. The asset must be traded in an informationally efficient market and the probability distribution of the price changes must be stationary. The formula derived to measure the bid-ask spread is $\text{Spread} = 2\sqrt{-\text{cov}}$, where "cov" is the first-order serial covariance of the price changes.

The effect of liquidity on the value of an asset is examined by Amihud and Mendelson (1986) who study the effect on share pricing. They explain that the bid-ask spread is a measure of the difference between the asking and selling price of an asset. The asking price contains a premium for immediate delivery of the asset and the selling (bid) price contains a discount for immediate sale. The bid-ask spread is the price that the market maker or dealer charges for bridging the gap between the buy and sell orders. The dealer provides liquidity and allows for immediate execution of the deal.

The authors observe that studies indicate that the bid-ask spread as a percentage of the share price has a strong negative correlation with attributes that are indicators of liquidity. These include trading volume, the number of shareholders, the number of dealers in the share and the continuity of the price (lack of volatility).

* If investors value shares on their returns net of trading costs then they will require a higher rate of return from those shares with higher bid-ask spreads. The liquidity of a share will therefore have an impact on its price. The investors' intended holding period of a share will also affect the price of share as a result of the bid-ask spread. The bid-ask spread is a cost at the purchase and selling dates. This cost is amortised over the holding period of the investment. Investors would prefer a longer holder period for high spread shares. Long term investors may therefore price shares differently to short term investors as the

amortisation periods of the transaction costs will differ. As an increase in liquidity will lead to an increase in value, improvements to trading mechanisms which could improve liquidity may lead to substantial economic benefits.

Bradfield, Barr and Affleck-Graves (1988) investigate the pricing of shares on the JSE using the Capital Asset Pricing Model (CAPM). They also study other effects on pricing, namely dividend yield, size and liquidity. They set out to determine the extent to which the liquidity of an asset affects its pricing structure.

While the concept of liquidity is well understood, the measurement thereof is fraught with difficulty and a number of different measures have been used. Most of the measures of liquidity involve using ratios of price changes to trading volume changes. The problem with these methods is that they also measure changes resulting from the arrival of new information which biases the results. The bid-ask spread has been suggested as a suitable measure of liquidity. As accurate records of bid-ask spreads were not available for the JSE, the authors use Roll's proposed method of calculating the spread which is discussed above. They are unable to find a significant relationship between the calculated spreads and the returns on the market.

De Villiers (1996) cites a JSE report which found that "liquidity on the JSE is unsatisfactorily low". The report of the research subcommittee on the future structure of the JSE defined liquidity as "annual turnover expressed as a percentage of market capitalisation".

De Villiers takes issue with this definition and suggests that low turnover and liquidity, although often associated, are not synonymous. Liquidity is regarded as the ease with which assets may be traded. Although turnover and liquidity are related, other factors affecting liquidity include information disclosure, market trading procedures and costs.

Ignoring these other factors rules out measures to increase liquidity without necessarily increasing market turnover.

Liquidity is desirable and investors will pay a premium for it. Liquidity lowers the required rate of return, reduces the cost of capital and increases real investment in the economy.

Liquidity is difficult to measure because it is a combination of a number of measurable properties. The ability to trade quickly and at a small discount are two elements of liquidity. Volume also plays a role as the price of a share traded at the same speed but with a larger volume may have a lower price. Similarly, a share sold at the same speed but a higher volume may be traded at a discount.

De Villiers concludes that none of the definitions of liquidity capture all its dimensions. Nevertheless, it is still an important property of shares which plays a role in the determination of value.

He found that the significance of liquidity has been quantified to some extent. Studies have shown that shares trade at discounts of up to 50% because of liquidity constraints. The findings illustrate the benefits to society of secondary markets where the reduced cost of capital to firms increases the amount of real investment in the economy.

De Villiers discusses a number of different measures that have been used to measure liquidity. The most commonly used measure is the bid-ask spread. Where bid and asked prices are not recorded, proxies for the bid-ask spread have been calculated. One of these, developed by Roll, and discussed above, was used by Bradfield, Barr and Affleck-Graves (1988) (see above). They did however express their concern at the accuracy of the measure. De Villiers notes that Karp (1994) found positive serial co-variances in his data and could not use the measure in his study.

The volatility ratio is the ratio of short term to long term volatility. It focuses on the price dimension of liquidity. The rationale for this measure is that illiquidity would increase the volatility of short term returns but have a lesser effect on long term returns. As the times at which transactions occur on the JSE are not recorded, collecting intra-day data to calculate the short-term volatility in the ratio is not practical.

The volume of trade is also used as a measure of liquidity. This measure has been criticised as it does not provide an indication of the sensitivity of the price to volume. As has been mentioned above, trading volume may indicate liquidity but the terms are not synonymous. An increase in volume, all else being equal, does however improve the tradability and thus the liquidity of an asset.

The liquidity ratio attempts to measure the relationship between the price and volume measures of liquidity. It is calculated by dividing the average daily volume of trade by average value of daily percentage price changes over the same period. A high value means that many shares were traded with a small change in price, and therefore that the asset is easily traded and liquid. It could also be regarded as the volume of trade required to move the price up or down by one percent. The liquidity ratio has been criticised as high volatility could result from frequent arrivals of new information without large trading volumes. This would nevertheless lead to a low ratio which might not indicate illiquidity.

The price elasticity could describe the relationship between the price and volume dimensions of liquidity. This measure is not commonly used as it has estimation problems and it does not consider the time dimension of liquidity.

The time to optimum disposal measure describes the relationship between the price and time dimensions of liquidity. The measure assumes that a trader uses the

optimum search and wait policy and then uses the time it takes to execute the sale as a measure of liquidity. If it is optimal for the trader to trade quickly then the asset is easily tradable and thus liquid. If it is optimal for the trader to wait a long time before trading, then the asset is considered to be illiquid. Although the measure has merit in theory, it has not been used in empirical studies. The estimation of the time to disposal from available data would be difficult.

De Villiers discusses some potential methods to improve liquidity. These are classified into methods to increase the volume of trade, improve the flow of information about shares to investors and changes to the trading system. The lowering of transaction costs like marketable securities tax, the lowering or removal of income taxes on share profits and the relaxation of exchange controls are examples of ways to increase volumes. Some analysts believe that the development of derivative markets will encourage trading in the underlying assets and thus increase liquidity.

The papers show the problems associated with the measurement of liquidity. It is nevertheless a desirable quality of financial assets and thus influences their value. Measures to improve liquidity will increase value.

2.6 A theoretical perspective of the impact of futures trading on the liquidity of the underlying assets

Edwards (1988) suggests that futures trading should bring more traders to the cash market, making the cash markets more liquid and, therefore, less volatile.

Grossman and Miller (1988) discuss the crash of October 1987 in terms of their model of market liquidity. The crash was a huge liquidity event with an imbalance in the demand and supply of immediacy. Both the cash spot and futures markets were flooded with huge sell orders. Each behaved according to its own market structure.

On the NYSE opening on individual shares can be delayed in order to give market makers the opportunity to balance orders. The S&P500 futures market, on the other hand, is designed to enable prices to adjust to news as soon as possible. In terms of their model the high demand for immediacy in the futures market, to hedge price risk in the spot market, means that the futures markets are geared to provide this immediacy. In the spot market, the lower costs of delayed execution mean that the market makers provide more of a search service than immediacy.

The delayed opening of trading in many shares on the NYSE on 19 October 1987 led to large price drops before trading had resumed in most shares by 11h00. The two markets were then working almost in concert before they became highly illiquid and unable to supply immediacy at the normal cost. The early gap between the spot and futures markets contributed to the belief that futures trading had dragged down the spot prices by signalling that heavy selling was on its way.

Grossman and Miller argue that restrictions imposed on programme trading broke the arbitrage link between the market makers in spot and futures markets. Arbitrageurs, who take offsetting positions in both markets, at almost the same time, can transfer some of the order imbalances from the first affected market to the other. The market makers resources can be used more effectively to reduce the trading costs in both markets. They therefore find it ironic that arbitrage programme trading is blamed for undermining investor confidence in the market.

Grossman (1988a) takes a broad view of the relationship between the futures and cash markets. He proposes that market makers in futures markets combine with market makers in the spot markets to enhance the overall liquidity of the equity market. Bessembinder and Seguin's (1992) findings support the theory of increased market liquidity.

The theoretical arguments support the hypothesis that index futures trading increases liquidity in the underlying cash market. The empirical work in the literature has focused on the effects on volatility of index futures trading. In many cases (Grossman, 1988a; Edwards 1988; Bessembinder and Seguin, 1992) higher liquidity associated with lower volatility was found to result from index futures trading.

This paper seeks to test this hypothesis empirically for the JSE.

2.7 Conclusion

A relationship between liquidity and volatility is evident from the studies. The literature deals with both concepts which together affect the value of financial assets.

Volatility is found to be related to a number of different factors and is a rational response to new information available to investors. This finding supports the efficient markets hypothesis and attempts to reduce volatility by regulating trading will reduce efficiency in the market and lead to even higher levels of volatility.

Most of the authors (e.g. Danthine, 1978; Forsythe, Palfrey and Plott, 1984, Edwards 1988; Grossman, 1988b; Miller, 1992) argue from a theoretical viewpoint that the introduction of index futures trading should reduce volatility in the underlying assets. There are some circumstances (Figlewski, 1991; Miller 1992) when the opposite effect could occur.

The empirical evidence on the impact of index futures trading on the volatility of the underlying assets is inconclusive. There are conflicting results in some of the studies (Figlewski, 1981; Edwards 1988), inconclusive results (Harris, 1989) and opposing views (Forsythe, Palfrey and Plott, 1984).

Further investigation on the effects of index futures trading on the JSE is therefore needed in order to provide additional evidence on the matter. The empirical analysis in this study covers the period from 1990 to 1997 and investigates the relationship between the volume and value of index futures trading for the three main share indices and the volatility of the underlying assets on the JSE.

While the concept of liquidity is well understood, it is not a readily measurable property of assets (Grossman and Miller, 1988; De Villiers, 1996). The papers show the problems associated with the measurement of liquidity (e.g. De Villiers, 1996). It is nevertheless a desirable quality of financial assets and thus influences their value. Measures to improve liquidity will increase value (De Villiers, 1996).

The theoretical arguments put forward in the literature support the hypothesis that index futures trading increases liquidity in the underlying cash market. Empirical work has tended to focus on the effects on volatility of index futures trading where higher liquidity, associated with lower volatility, was found to result from index futures trading (Grossman, 1988b; Edwards 1988; Bessembinder and Seguin, 1992). This paper seeks to test this hypothesis empirically for the JSE.

CHAPTER THREE

RESEARCH METHOD

3.1 Introduction

The literature review reveals that the empirical evidence on the impact of index futures trading on the volatility of the underlying assets is inconclusive.

The first objective of this study is to investigate further the effects of index futures trading on the volatility of JSE. The following empirical analysis, of the period from 1990 to 1997, investigates the relationship between the volume and value of index futures trading for the three main share indices and the volatility of the underlying assets on the JSE.

The theoretical arguments in the literature review add weight to the hypothesis that index futures trading increases liquidity in the underlying asset market. The second objective of this paper is to test this hypothesis for the JSE.

3.2 The impact of index futures trading on the volatility of the JSE

The impact of index futures trading on the volatility of the underlying assets on the Johannesburg Stock exchange is assessed by using linear regression. A measure of the volatility of the underlying assets is determined first. The impact of index futures trading is then assessed with reference to the volume and value of index futures trading.

3.2.1 The measurement of the volatility of the underlying assets

Volatility has been measured using a number of different formulae (Figlewski, 1981; Grossman, 1988b; Edwards 1988; Schwert, 1989; Ederington and Lee, 1993; Lee, Ready and Seguin, 1994; Stoll and Hunt, 1996; Vanden Baviere and De Villiers, 1997). The standard deviation of daily log returns used by Ederington and Lee (1993), Stoll and Hunt (1996), and Vanden Baviere and De Villiers (1997) has been used in this study. The measure is widely used and fairly simple to calculate. In addition, it does not require more information than is available on the JSE.

The log return is calculated using the formula:

$$R_t = \ln\left(\frac{P_t}{P_{t-1}}\right) \text{ where:}$$

R_t = the log return in period t

P_t = the closing price at the end of period t

P_{t-1} = the opening price at the start of period t

For the purposes of this study the price referred to is the index level.

The time series being investigated is the price of the underlying assets, the shares, on the JSE. The ALSI, ALSI40, INDI, INDI25, GLDI and GLDI10 indices have been used as proxies for the aggregated prices of all the underlying assets. In this analysis, volatility is measured by calculating the standard deviation of the daily log returns for each month from May 1990 to June 1997.

There are 86 observations which form the sample of the population of monthly volatility measures of the prices of the underlying assets, the shares, on the JSE.

3.2.2 The volume and value of index futures trading

Contracts are currently closed out on the third Friday, or previous business day, of March, June, September and December. Prior to the June 1997 contracts, the expiry dates were the 15th of March, June, September and December or the next business day. The expiry date is due to change again in 1998 to the last Thursday of the same months or the previous business day.

Each contract is identified by its index, its expiry date and its term, which is a multiple of three months, i.e. three, six, nine, twelve, fifteen, eighteen, twenty-one and in some cases even twenty-four months.

At any point in time only one contract per index of each term can be traded. There may however be contracts of different terms trading simultaneously. The larger trading volumes normally occur in the near (three month) contracts while trading in middle (six month) and far (nine months and over) contracts is usually lower. There were certain periods covered by the study during which this did not apply and the trading volumes on all contracts were therefore aggregated for each day in order to arrive at the total daily volumes.

The daily volumes were then aggregated for each of the 86 months covered by the study. The number of trading days in each month varies with the number of days in the month and the number of national holidays. The total volume for each calendar month was therefore divided by the number of trading days in order to determine the average total volume traded per trading day for each month.

There are 86 observations which form the sample of the population of monthly volumes of futures contracts trading for each of the indices.

The total daily trading values, being the volumes multiplied by the ruling futures price at the time of the deals, was

also accumulated in the same way. The regression analyses have been performed using both volumes and values traded in the futures market.

The 86 observations were used for the ALSI. There was no recorded trade in GLDI and INDI futures during October, November and the first 14 days of December in 1992. These three months were therefore excluded from the sample leaving 83 observations.

The indices on which the futures are based were changed from the ALSI, GLDI and INDI to the ALSI40, GLDI0, and INDI25 from 15 March 1996. The spot indices were changed half way through the month and the differences between the levels on and after 15 March 1996 are large enough to distort the calculated volatility. The observations for this month have therefore also been excluded. The number of observations was thus reduced to 85 for the ALSI and 82 for the GLDI and the INDI futures. As the actual values of the indices are not relevant to this analysis, no further adjustment has been made for the change in the index base.

3.2.3 Regression method: Spot price volatility and the volume of index futures trading

The analysis has been performed by regressing the volatility of the underlying assets, calculated as described above, with the total volume of trade in the related futures, as calculated above:

$$\sigma_t = c + \beta \text{ fvol}_t + \varepsilon_t$$

where

- σ_t = Standard deviation of returns in month t
- fvol_t = Average daily futures volume in month t
- c = Regression constant
- β = Coefficient of the dependent variable
- ε_t = Random error term

If the slope of the regression line (β) is not significantly different from zero then this means that the independent variable is not a significant explanatory variable for the dependent variable.

The hypothesis test is as follows:

Null (H_0) : The volume of index futures trading is not a significant explanatory variable for the volatility of the underlying asset market. ($\beta = 0$)

Alternative (H_1): The volume of index futures trading is a significant explanatory variable for the volatility of the underlying asset market. ($\beta \neq 0$)

The null hypothesis is rejected if the regression coefficient (β) is significantly different from zero. All the regression results have been considered using the t-statistics for β and c at a 95% confidence level.

Serial correlation has been tested for all the regressions using the Durbin-Watson d-statistic. The results have been evaluated using the tabulated upper and lower bounds for the number of observations and one independent variable.

3.2.4 Regression method: Spot price volatility and the value of index futures trading

The analysis has also been performed by regressing the volatility of the underlying assets, calculated as described above, with the total value traded in the related futures, as calculated above:

$$\sigma_t = c + \beta \text{fval}_t + \varepsilon_t$$

where

σ_t = Standard deviation of returns in month t

fval_t = Average daily futures value in month t

c = Regression constant

β = Coefficient of the dependent variable

ε_t = Random error term

The hypothesis test is as follows:

Null (H_0) : The value of index futures trading is not a significant explanatory for the volatility of the underlying asset market. ($\beta = 0$)

Alternative (H_1): The value of index futures trading is a significant explanatory variable for the volatility of the underlying asset market. ($\beta \neq 0$)

The null hypothesis is rejected if the regression coefficient (β) is significantly different from zero.

3.3 The impact of index futures trading on the liquidity of the JSE

The impact of index futures trading on the liquidity of the underlying assets on the JSE is assessed by using regression techniques.

Two measures of the liquidity of the underlying assets are selected first. The impact of index futures trading is then assessed with reference to the volume and value of index futures trading.

3.3.1 The measurement of the liquidity of the underlying assets

The liquidity has been measured using both the liquidity ratio and volume of trade in the spot market.

The liquidity ratio is calculated by dividing the average daily volume of trade in the spot market during a time period by the average value of the daily percentage price change over the same period (De Villiers, 1996). In this case, weekly data was used so the formula for each week (t) is as follows:

$$\text{Liquidity Ratio}_t = \frac{\text{Average daily volume of trade (spot)}_t}{\text{Average daily \% price change (spot)}_t}$$

Weekly trading volumes for the constituents of the ALSI40 were only available as far back as October 1995. Weekly trading volumes for the constituents of the INDI25 and the GLDI10 were available from June 1995.

The liquidity ratios have been calculated on a weekly basis for these periods as follows. The absolute values of the daily percentage price changes were calculated. These were then totalled for each week and divided by the number of trading days for the week in order to determine the average daily percentage price changes of the underlying assets.

The volume of trading was also totalled for each week and divided by the number of trading days in order to determine the average daily trading volume of the underlying assets. The liquidity ratios were then calculated for each week using the formula above.

The ALSI observations cover the period from 2 October 1995 to 11 July 1997, a total of 94 weeks. There were five weeks during the period for which no data was available so the final sample consists of 89 observations.

The GLDI and INDI observations cover the period from 19 June 1995 to 11 July 1997, a total of 109 weeks. There were five weeks during the period for which no data was available so the final sample consists of 104 observations.

3.3.3 The volume and value of trade in the spot market

As was the case for the volatility analysis, the volume of futures trading on all contracts were aggregated for each day in order to arrive at the total daily volumes.

The daily volumes were then aggregated for each of the weeks covered by the study. As the number of trading days in each week can vary, the total volume for each week was divided by the number of trading days in order to determine the average daily volume for each week. The average daily value of futures traded for each week was calculated in the same way.

3.3.4 Regression Method: Spot volume and the volume of index futures trading

The analysis has been performed by regressing the liquidity of the underlying assets, calculated as described above, on the volume of trade in the related futures, as calculated above:

$$s_t = c + \beta \text{ fvol}_t + \varepsilon_t$$

where

s_t = Average daily spot volume in week t

fvol_t = Average daily futures volume in week t

c = Regression constant

β = Coefficient of the dependent variable

ε_t = Random error term

The hypothesis test is as follows:

Null (H_0) : The volume of index futures trading is not a significant explanatory variable for the liquidity of the underlying asset market. ($\beta = 0$)

Alternative (H_1): The volume of index futures trading is a significant explanatory variable for the liquidity of the underlying asset market.
($\beta \neq 0$)

The null hypothesis is rejected if the regression coefficient (β) is significantly different from zero.

3.3.7 Regression Method: Liquidity ratio and the value of index futures trading

The analysis has been performed by regressing the liquidity of the underlying assets, calculated as described above, with the value of trade in the related futures, as calculated above:

$$lrat_t = c + \beta fval_t + \varepsilon_t$$

where

$lrat_t$ = Average daily spot volume in week t

$fval_t$ = Average daily futures value traded in week t

c = Regression constant

β = Coefficient of the dependent variable

ε_t = Random error term

The hypothesis test is as follows:

Null (H_0) : The volume of index futures trading is not a significant explanatory variable for the liquidity of the underlying asset market. ($\beta = 0$)

Alternative (H_1): The volume of index futures trading is a significant explanatory variable for the liquidity of the underlying asset market.

($\beta \neq 0$)

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CHAPTER FOUR

THE DATA USED IN THE STUDY

4.1 Introduction

There are a number of time series used in the empirical analyses in the next chapter. This chapter describes the data to be used for the empirical analyses.

4.2 The time series used in the study

This study deals with the following time series:

Daily index levels (as surrogates for the price levels in the spot market)

- All Share Index Level (ALSI) and ALSI40 Level
- Industrial Index Level (INDI) and INDI25 Level
- All Gold Index Level (GLDI) and GLDI10 Level

Daily value of futures traded on the SAFEX share index futures market

- ALSI and ALSI40 value of futures traded
- INDI and INDI25 value of futures traded
- GLDI and GLDI10 value of futures traded

Daily volumes of futures traded (number of contracts traded) on the SAFEX share index futures market

- ALSI and ALSI40 volumes of futures traded
- INDI and INDI25 volumes of futures traded
- GLDI and GLDI10 volumes of futures traded

Weekly volumes traded (no of shares) in the constituents of the indices (as surrogates for the volumes traded in the spot market)

- ALSI40 constituent volumes
- INDI25 constituent volumes
- GLDI10 constituent volumes

In addition to these, other time series are derived from the above as required. These are measures of volatility and liquidity as calculated in the previous chapter.

4.3 The index levels

The closing index levels were available on a daily basis.

The Johannesburg Stock Exchange calculates the share indices on a weighted average basis according to the following formula (Levett, 1991):

$$\text{INDEX}_t = \frac{k \sum_{i=1}^n P_{it} W_{it}}{\sum_{i=1}^n W_{it}}$$

where

- INDEX_t = Value of the index at time t
 P_{it} = Price per share of constituent i at time t
 n = Number of constituents in the index
 W_{it} = Number of eligible shares for constituent i at t
 k = Constant chosen to base the index to a value at the starting date of the index.

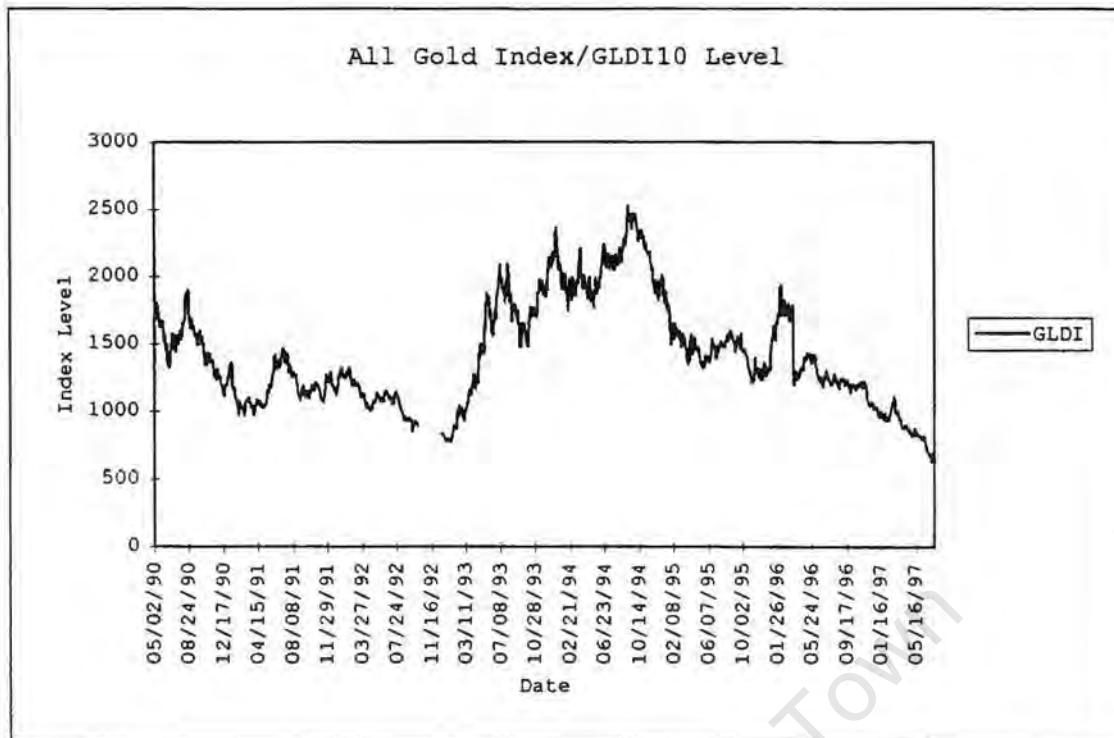
The All Share, All Gold and Industrial indices are based on a selection of shares with the largest market capitalisation which make up approximately 80% of the sector capitalisation. Since 1995 the ALSI40, INDI25 and GLDI10 indices have also been calculated. These indices are calculated in a similar manner but are based on the top forty, twenty-five and ten shares respectively on a market capitalisation basis.

The ALSI, GLDI and INDI levels have been used as surrogates for price of the underlying assets in the market until 15 March 1996 when the SAFEX futures started trading on the ALSI40, INDI25 and GLDI10 indices. There was a small gap between the two sets of indices at this date and this has been dealt with in the empirical analyses.

Graphical representations of the index levels are shown below:



The graph indicates the fluctuations in the ALSI over the seven year period. There is a general upward trend in the index.



There is a gap in the chart from 1 October to 14 December 1992. During this period there was no recorded trading in GLDI futures. As the index data was linked to the futures trading data, no daily index levels were available for this period. The index does not show a similar growth trend to that of the ALSI.



There is a gap in the data, as for the INDI, for the period from 1 October 1992 to 15 December 1992. Overall there is a strong upward trend in the index over the period.

4.4 Volumes traded in the constituents of the indices

Volumes (number of shares traded) are recorded on a daily basis for the constituents of each index on the JSE. For this study, weekly volumes were used for the ALSI40, INDI25 and GLDI10.

The volumes are calculated as follows:

$$SVOL_t = \sum_{i=1}^n v_{it}$$

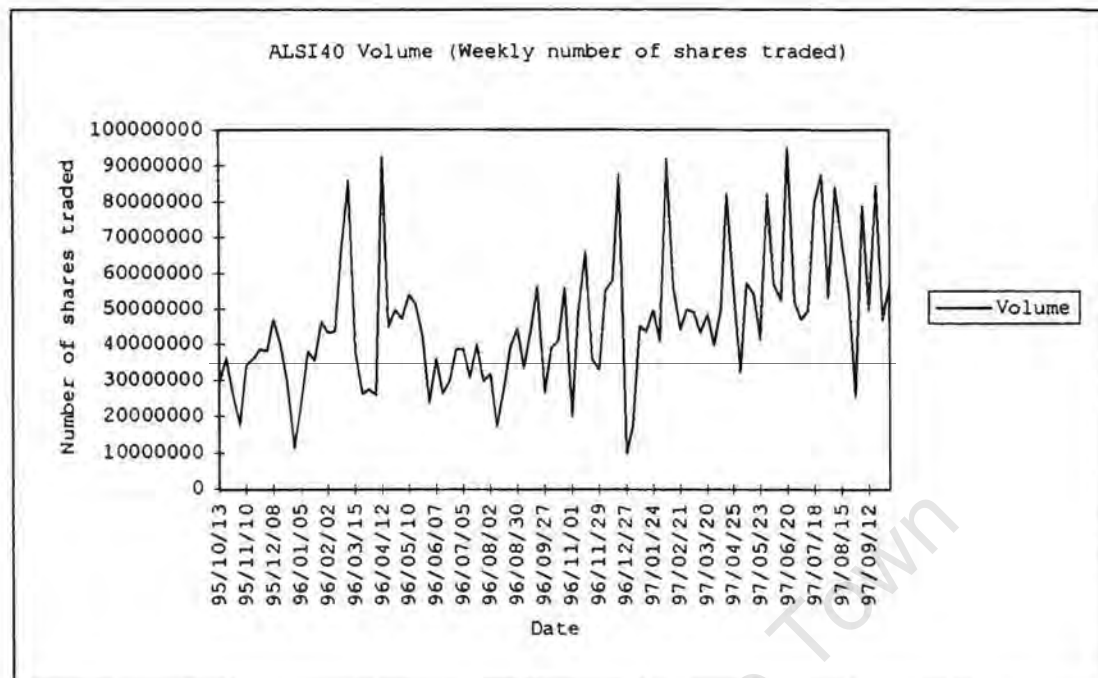
where

$SVOL_t$ = Volume of shares traded in index for week t

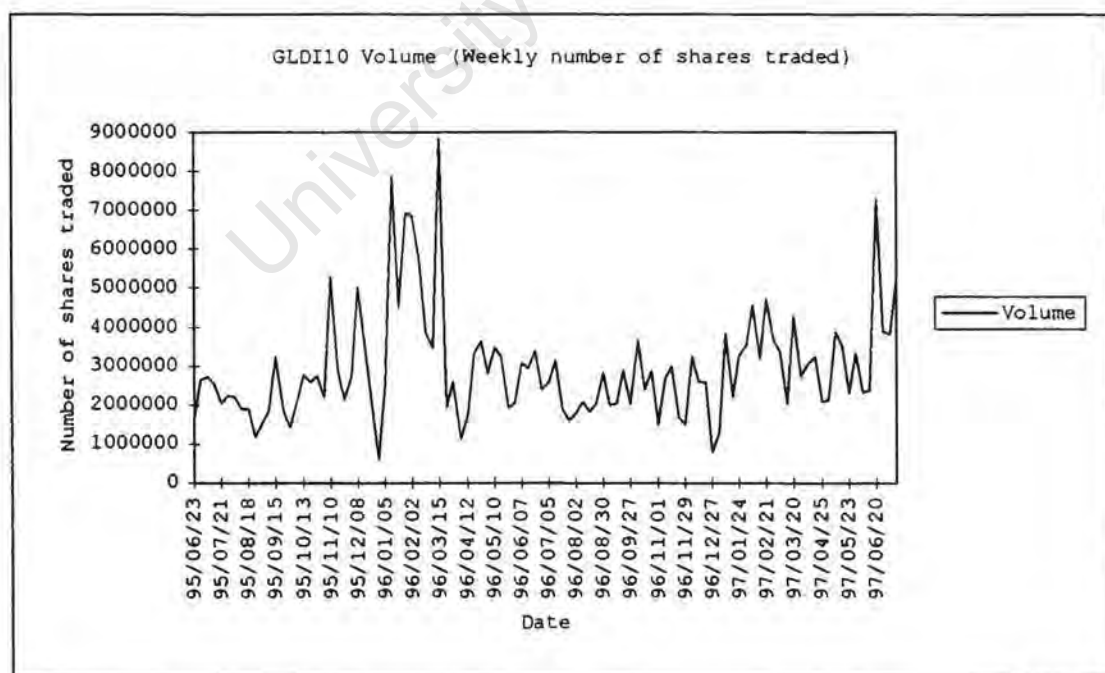
v_{it} = Volume of shares traded for constituent i for week t

n = Number of constituents in the index

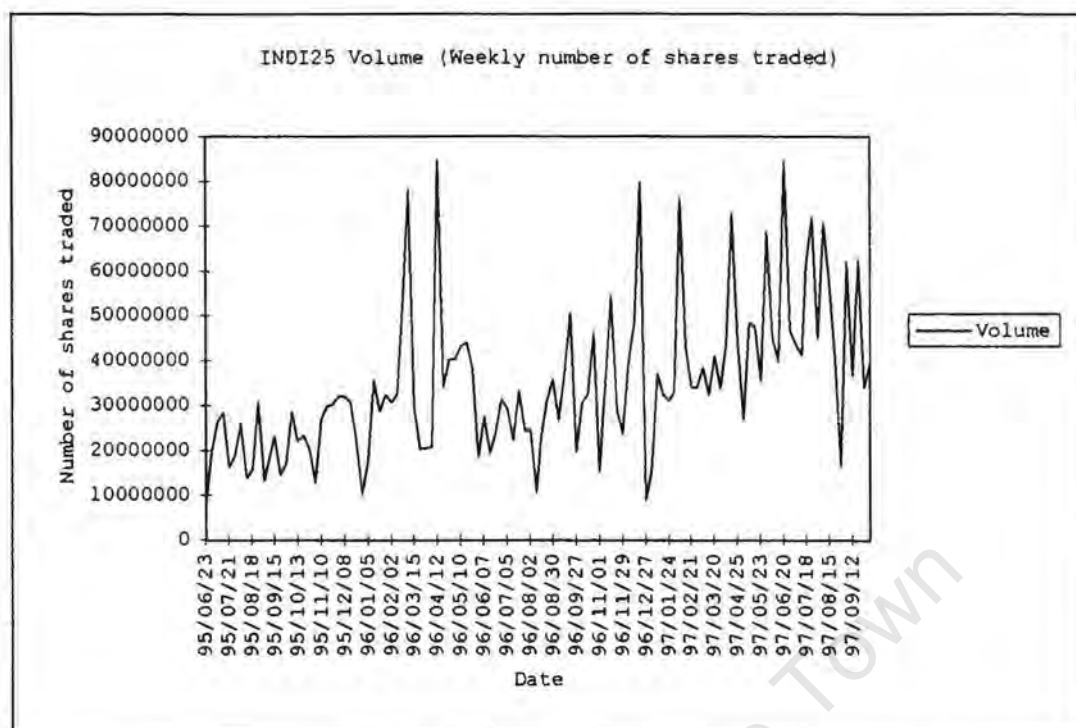
Graphs of the volumes traded appear below:



The data was available for the two-year period from October 1995 to September 1997. There is a steady upward trend in trading volumes over the two year period.



The data for the GLDI10 and the INDI25 was available from July 1995 to September 1997.



Both graphs show an upward trend in the volume of shares traded on the JSE.

4.5 Daily value of futures traded

The value of each future traded is determined by multiplying the index level by R10 (SAFEX, 1997). In order to calculate the daily value of futures traded for each index, the total value of each contract traded must be aggregated.

At any point in time there could theoretically be up to eight contracts trading on any one index (three, six, nine, twelve, fifteen, eighteen, twenty-one and twenty-four month contracts). The total values for each of these contracts also need to be aggregated.

The formula is as follows:

$$FVAL_t = \sum_{i=1}^n v_{it}$$

where

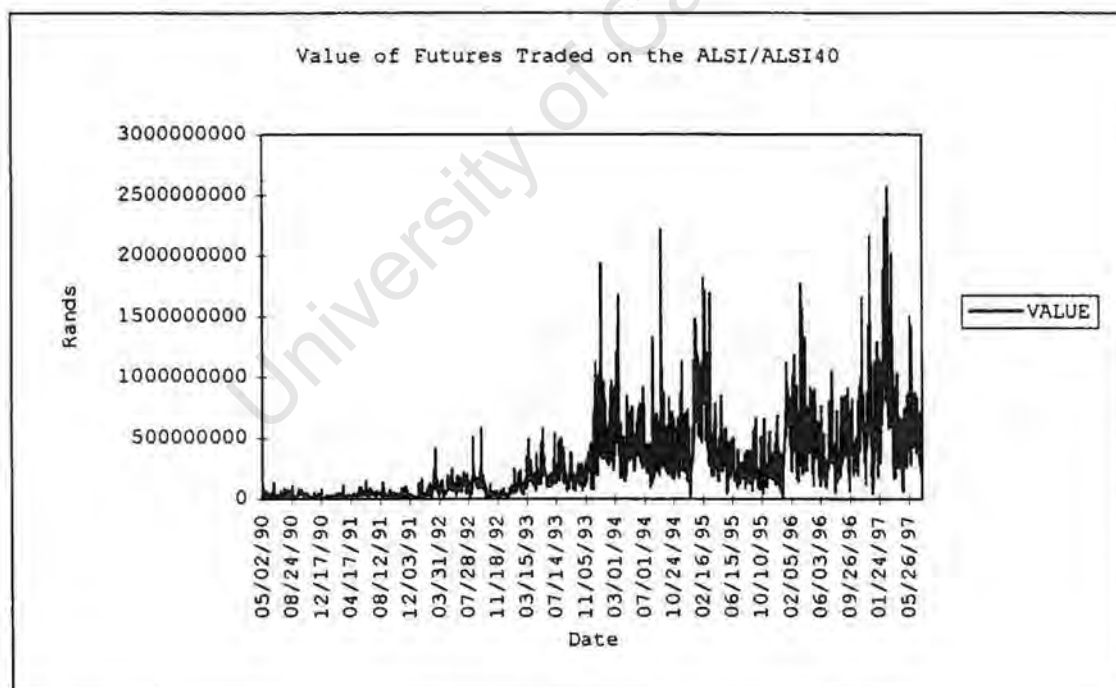
$FVAL_t$ = Value of futures traded in the index for day t

v_{it} = Value of futures traded for contract i for day t

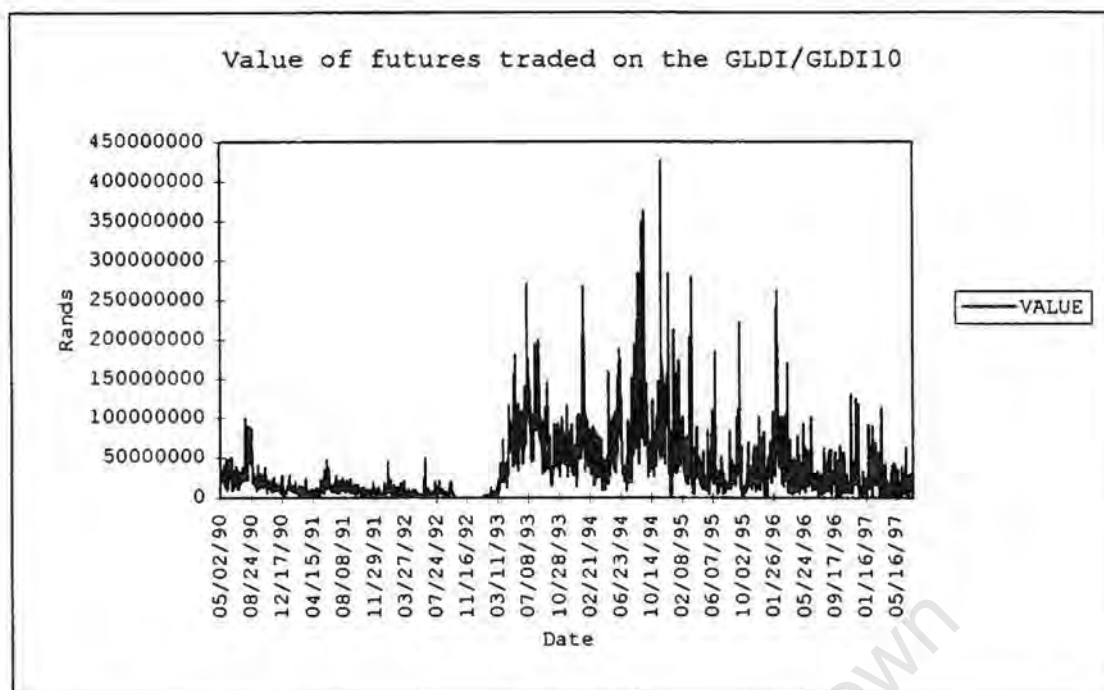
n = Number of contract periods traded in the index on day t (i.e. three, six, twelve months, etc)

The resultant value is a product of the number of contracts traded (the volume) and the value of the underlying index. This value has been used as a measure of the trading on the SAFEX.

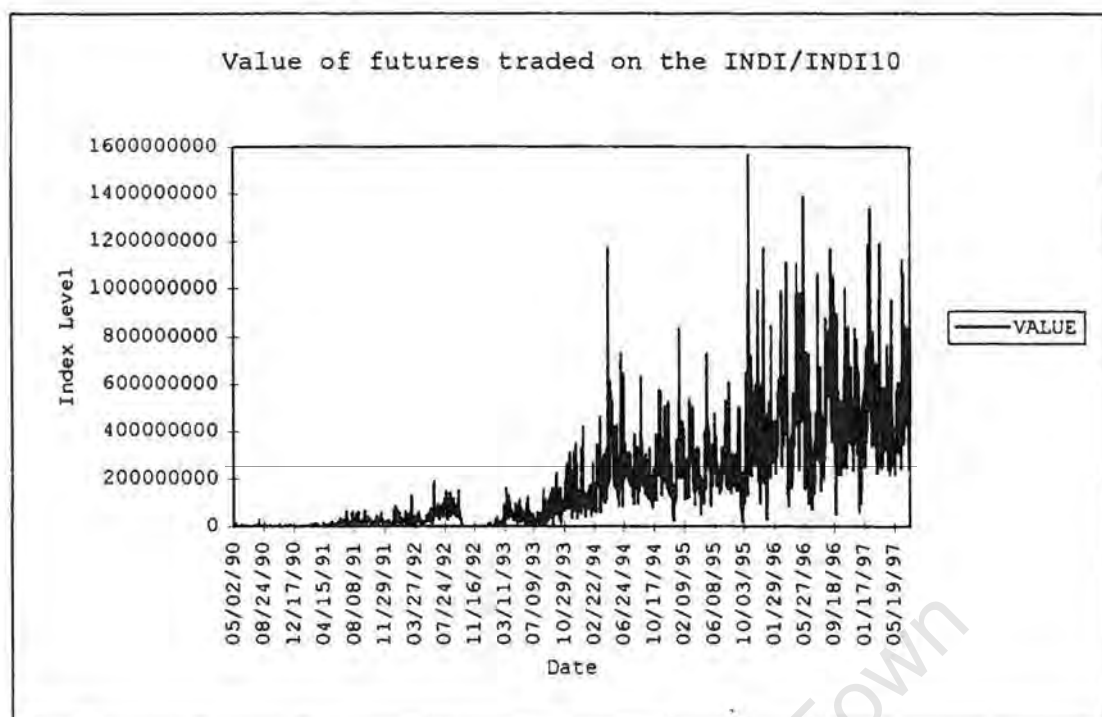
The value of futures traded on the SAFEX is shown graphically below.



The large increase in the value of ALSI/ALSI40 futures trading over the seven year period is evident from the graph.



There is a gap in the data from 1 October 1992 to 15 December 1992 as explained above. The daily value of contracts traded was relatively low until mid-February 1993 when the trend begins a climb to a peak in September 1994. This is followed by a steady downward trend to July 1997. The graph shows a similar pattern to that of the underlying index level. As the value is a product of the index and the number of contracts traded, this trend is at least partly as a result of the fluctuations in the index level. A similar pattern was evident for the ALSI contracts.



There is again a gap in the data from 1 October 1992 to 15 December 1992. The graph shows a steady growth in value traded. The upward trend in the index level will have contributed to the growth.

4.6 Daily volume (no. of contracts) of futures traded

The volume is the total number of contracts for all futures trading on a particular index for the day. This is also used as a measure of the trading on the SAFEX. It is not affected by the value of underlying index.

The formula is as follows:

$$FVOL_t = \sum_{i=1}^n v_{it}$$

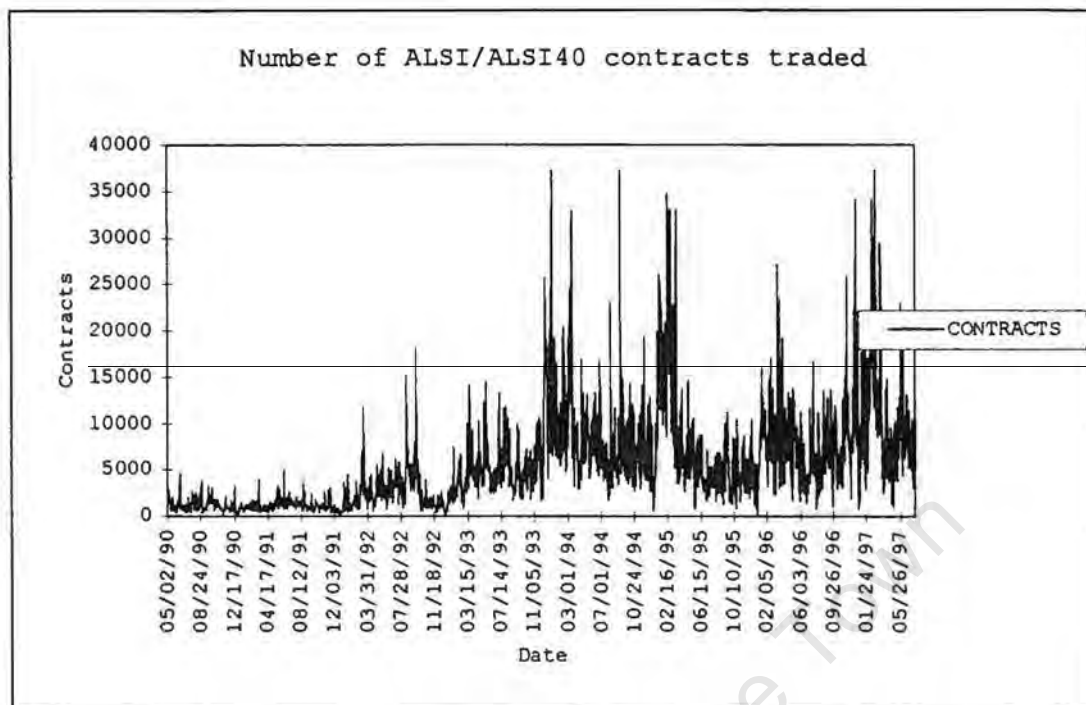
where

$FVOL_t$ = Volume of futures traded in the index for day t

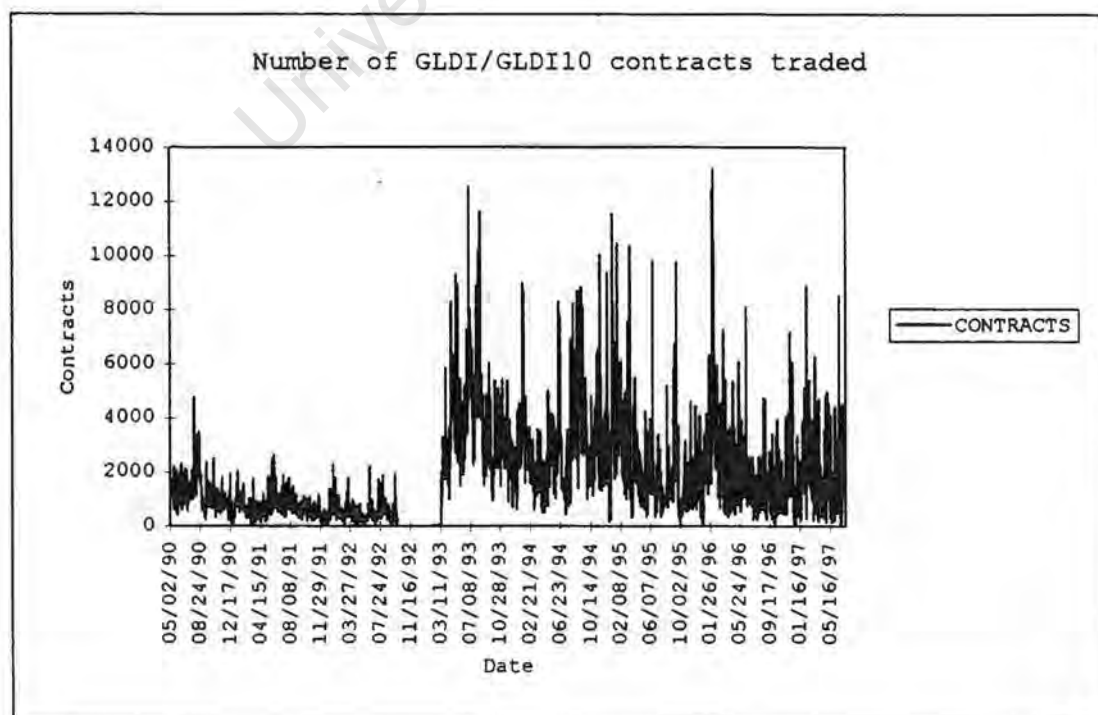
v_{it} = Volume of futures traded for contract i for day t

n = Number of contract periods traded in the index on day t (i.e. three, six, twelve months, etc.)

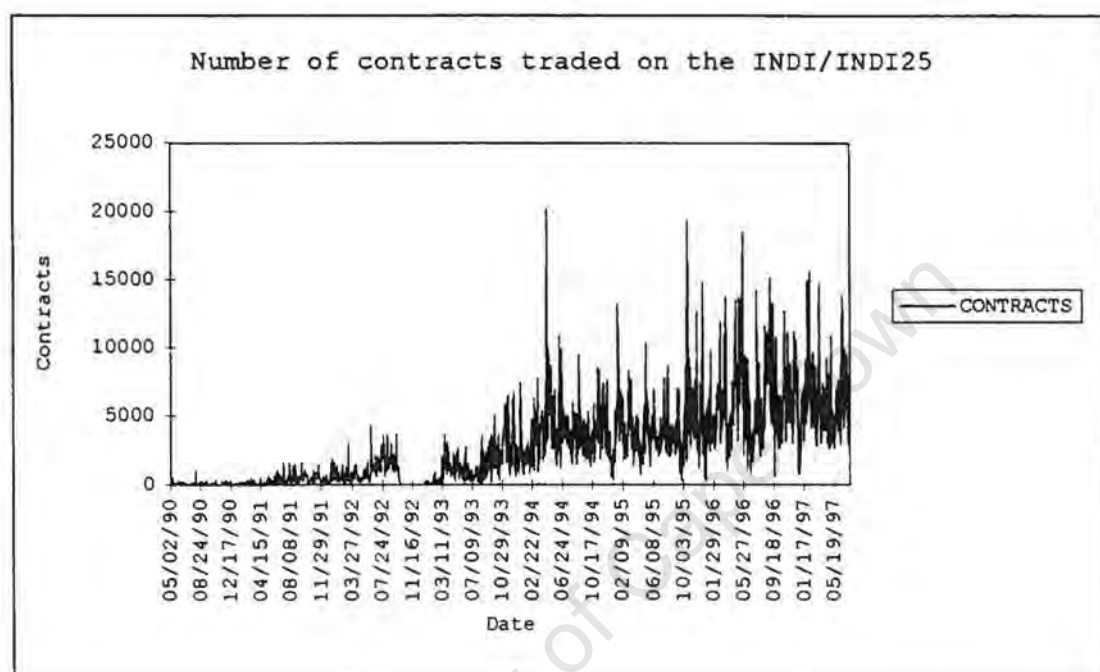
Graphs of the volume of futures trading appear below.



As expected, this graph shows a similar pattern to that of the futures values traded. The peaks and troughs are not magnified by the level of the underlying index. The increase in the volume over the period under review is clearly evident.



The graph shows the contrast between the low volumes traded before October 1992 and the relatively high volumes from March 1994. Although the trend is not as marked as that in the graph of the trading values, there has been a steady decrease in the volume of gold futures traded from March 1992 to July 1997.



A steady increase in the volume of INDI contracts is evident from the graph.

CHAPTER FIVE

RESULTS OF THE EMPRICAL RESEARCH

5.1 Introduction

The results of the regressions are listed below for each index. The tables of regression results contain the number of observations (Obs), the regression coefficient (β), the regression constant (c), the coefficient of variation (r^2), and the Durbin-Watson d-statistic. The relevant t-statistics for β and c are listed in brackets below each result at a 95% confidence level.

Results where β is not significantly different from 0 (at the 95% confidence level) are marked with a *. This notation has been used as, more often than not, the results were significant. Where d indicates that the possibility of serial correlation cannot be rejected, it is marked with a $^+$. Where the Durbin-Watson test is inconclusive it is marked with a ϕ .

5.2 The impact of index futures trading on the volatility of the JSE

5.2.1 Results: The volume of index futures trading

The results of regressing the volatility of the underlying assets on the volume of futures trading are as follows:

Index	Obs	Beta (t-stat)	Constant (t-stat)	r^2	d
ALSI	85	-8.68575E-08 (-0.718306)*	0.009131421 (11.070802)	0.006178	1.76321
GLDI	82	2.10109E-06 (3.6678147)	0.017488444 (13.211059)	0.143953	1.03027 $^+$
INDI	82	4.82168E-07 (3.0610968)	0.006386071 (11.215249)	0.104848	1.77778

From the samples, the volume of futures trading is a significant explanatory variable for the volatility of the underlying assets for the GLDI and the INDI but not for the ALSI.

It is interesting to note that the β for the ALSI is negative. The magnitude of the slope is however very small and the β is also not significant at the 95% level. The ALSI represents the entire market which includes those shares represented by the GLDI and the INDI. There are however a number of other sectors, like the financial sector, which are not represented by the GLDI and the INDI. It is therefore not inexplicable that the ALSI should show a different behaviour to the other two indices.

The Durbin-Watson statistic is significant for GLDI which means that serial correlation has reduced the efficiency of the regression but this will not bias the estimates of the slope and intercept terms (Copeland & Weston, 1992).

The null hypothesis cannot be rejected for the ALSI. The null hypothesis is rejected for the GLDI and the INDI. The alternative (H_1) is accepted that the volume of index futures trading is a significant explanatory variable for the volatility of the underlying asset market for these two indices. There is thus a significant positive relationship between the volume of index futures trading and the volatility of the underlying assets for the GLDI and the INDI.

5.2.2 Results: The value of index futures trading

The following table contains the results of the regression of the volatility of the underlying assets on the value of futures trading:

Index	Obs	Beta (t-stat)	Constant (t-stat)	r^2	d
ALSI	85	-2.05518E-12 -1.0714205*	0.009265 12.319816	0.013642	1.782739
GLDI	82	7.1685E-11 3.02694983	0.0188613 16.281253	0.102761	1.020562*
INDI	82	5.76403E-12 2.93630788	0.0066077 12.513212	0.097289	1.787106

The results are very similar to those of the previous regressions. The value of futures trading is a significant explanatory variable for the volatility of the underlying assets for the GLDI and the INDI but not for the ALSI. The d statistic is again significant for the GLDI, indicating the problem of serial correlation.

The null hypothesis cannot be rejected for the ALSI. The null hypothesis is rejected for the GLDI and the INDI. The alternative (H_1) is accepted that the value of index futures trading is a significant explanatory variable for the volatility of the underlying asset market for these two indices.

As for the volume of futures trading, there is a significant positive relationship between the value of index futures trading and the volatility of the underlying assets for the GLDI and the INDI.

5.3 The impact of index futures trading on the liquidity of the JSE

5.3.1 Results: The volume of trading on the JSE and the volume of trade in futures contracts

The volume of trade in the underlying assets is used as a measure of liquidity. The results of the regression of the underlying assets volume on the futures volume are as follows:

Index	Obs	Beta (t-stat)	Constant (t-stat)	r^2	d
ALSI	89	429.5437545 (4.6360149)	5898404.397 (7.0592235)	0.1981022	1.989271
GLDI	104	725.1166447 (6.6563095)	1518296.342 (6.2266111)	0.3028332	1.545482 [†]
INDI	104	635.7067212 (4.3894909)	3590746.225 (4.1893097)	0.1588852	1.599192 [†]

From the samples, the volume of futures trading is a significant explanatory variable for the liquidity of the underlying assets for all of the indices. The Durbin-Watson statistic is inconclusive for the GLDI and the INDI.

The null hypothesis is thus rejected for all three indices. There is thus a significant positive relationship between the volume of futures trading and the liquidity of the underlying assets as measured by the volume of trading.

5.3.2 Results: The volume of trading on the JSE and the value of trade in futures contracts

The results of the regression of spot volumes on the value of futures traded are listed below:

Index	Obs	Beta (t-stat)	Constant (t-stat)	r^2	d
ALSI	89	6.282491063 (4.505788047)	5993861.683 (7.162772774)	0.189205253	2.0018317
GLDI	104	6.08055616 (4.880673626)	442625.9552 (9.834278857)	0.189324356	1.4015744 ⁺
INDI	104	8.419370286 (4.735837628)	3429454.315 (4.735837628)	0.18024986	1.6651135

From the samples, the value of futures trading is a significant explanatory variable for the liquidity of the underlying assets for all of the indices. The Durbin-Watson statistic is significant for the GLDI.

As for the previous regression, the null hypothesis is rejected for all three indices. There is a significant positive relationship between the value of futures trading and the liquidity of the underlying assets as measured by the volume of trade in the index constituents.

5.3.3. Results: The liquidity ratios of the underlying assets the volume of trade in futures contracts

The results of the regression of spot liquidity ratios on the volume of futures traded are listed below:

Index	Obs	Beta (t-stat)	Constant (t-stat)	r^2	d
ALSI	89	262.9743023 (0.9309157)*	15745302.8 (6.1806338)	0.0098627	1.62626778
GLDI	104	0.354666257 (0.2695000)*	467631.2321 (9.8358446)	0.0007116	2.23276506
INDI	104	-420.349669 (-0.809226)*	16337206.66 (5.3141940)	0.0063791	1.89017707

The null hypothesis cannot be rejected for all three indices. There is thus no significant relationship between the volume of futures trading and the liquidity of the underlying assets as measured using the liquidity ratio.

5.3.4. Results: The liquidity ratios of the underlying assets the value of trade in futures contracts

The results of the regression of spot liquidity ratios on the value of futures traded are as follows:

Index	Obs	Beta (t-stat)	Constant (t-stat)	r^2	d
ALSI	89	4.459600772 (1.056345)*	15476176.42 (6.1081379)	0.0126636	1.6379733
GLDI	104	0.354666257 (0.269500)*	467631.2321 (9.8358446)	0.0007116	2.2327651
INDI	104	-3.79075551 (-0.58600)*	15677778.59 (5.1687184)	0.0033553	1.8858041

The results are similar to those of the previous regression. Once again the null hypothesis cannot be rejected for all three indices.

5.4 Conclusion

5.4.1 Tests of the effect on the volatility of the underlying assets

The results of the regression tests are summarised as follows:

Index	Independent Variable	Significant relationship with underlying asset volatility
ALSI	Futures volumes	No
GLDI	Futures volumes	Yes
INDI	Futures volumes	Yes
ALSI	Futures value traded	No
GLDI	Futures value traded	Yes
INDI	Futures value traded	Yes

5.4.2 Discussion of the results

The empirical analysis in the study covers the period from 1990 to 1997 and investigates the relationship between the volume and value of index futures trading for the three main indices and the volatility of the underlying assets on the JSE.

The results of the regression tests indicate significant positive relationships between futures trading activity and the volatility of the underlying assets for the All Gold Index and the Industrial Index. This indicates that increased futures trading is associated with increased volatility in the underlying assets. The relationships were not significant for the All Share Index.

The results support the hypothesis that index futures trading increases the volatility of the underlying assets.

5.4.3 Tests on the effect of the liquidity of the underlying assets

The following tables summarise the results of the regression tests of the impact of index futures trading on the liquidity of the underlying assets.

Dependent variable: Volume of trade in the underlying assets		
Index	Independent Variable	Significant relationship with underlying asset liquidity
ALSI	Futures volumes	Yes
GLDI	Futures volumes	Yes
INDI	Futures volumes	Yes
ALSI	Futures value traded	Yes
GLDI	Futures value traded	Yes
INDI	Futures value traded	Yes

Dependent variable: Liquidity ratios		
Index	Independent Variable	Significant relationship with underlying asset liquidity
ALSI	Futures volumes	No
GLDI	Futures volumes	No
INDI	Futures volumes	No
ALSI	Futures value traded	No
GLDI	Futures value traded	No
INDI	Futures value traded	No

5.4.4 Discussion of the results

The regression tests, using the volume of trade in the constituents of the indices as a measure of the liquidity of the underlying assets, indicate significant relationships with both the volume and value of related futures trading for all three indices. The results indicate a significant positive relationship between the level of futures trading activity and the liquidity of the cash market.

Using the liquidity ratio as a measure of the liquidity of the underlying assets did not result in any significant relationships between the liquidity of the underlying assets and the level of futures trading.

The conflicting results emphasise the problems with the measurement of liquidity. Where, however, there is an increase in volume, all else being equal, this will improve the tradability and thus the liquidity of an asset (De Villiers, 1992). The findings thus support the hypothesis that index futures trading is associated with greater liquidity in the underlying assets.

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CHAPTER SIX

CONCLUSION

6.1 Introduction

High levels of volatility lead to uncertainty and increase the risk associated with investments in the market. Measures to reduce volatility without affecting expected returns will increase the value of assets. Low levels of liquidity mean that shares are not readily traded. This increases the risk associated with the shares as investors are unsure of a ready market for their investments.

The purpose of this study is to investigate what effect index futures trading has had on the liquidity and volatility of the underlying asset market on the Johannesburg Stock Exchange.

6.2 The impact of index futures trading on the volatility of the underlying assets on the JSE

The findings in the literature support the efficient markets hypothesis and the volatility of share prices is found to be a rational response to information by investors. Regulatory measures to reduce volatility by imposing trading halts result in reduced efficiency in the market and even higher levels of volatility.

There are conflicting views in the literature on the effects of index futures trading on the volatility of the underlying assets (Forsythe, Palfrey and Plott, 1984). The empirical evidence in the literature is inconclusive and includes conflicting results (Figlewski, 1981; Edwards 1988).

Most of the authors (e.g. Danthine, 1978; Forsythe, Palfrey and Plott, 1984, Edwards 1988; Grossman, 1988b; Miller, 1992) argue from a theoretical viewpoint that the introduction of

index futures trading should reduce volatility in the underlying assets. There are some circumstances (Figlewski, 1991; Miller 1992) when the opposite effect could occur.

The empirical analysis of the period from 1990 to 1997 investigates the relationship between the volume and value of index futures trading for the All Share Index, All Gold Index and the Industrial Index and the volatility of the underlying assets on the JSE.

The regression test results show a significant positive relationship between futures trading activity and the volatility of the underlying assets for the All Gold Index and the Industrial Index. Increased futures trading is thus associated with increased volatility in the underlying assets. The relationships were not significant for the All Share Index.

The results support the hypothesis that index futures trading increases the volatility of the underlying assets.

6.3 The impact of index futures trading on the liquidity of the underlying assets on the JSE

While the concept of liquidity is well understood, it is not a readily measurable property of assets (Grossman and Miller, 1988; De Villiers, 1996). The literature indicates the problems associated with the measurement of liquidity. It is nevertheless a desirable quality of financial assets and thus influences their value. Attempts to improve liquidity will increase value.

The theoretical arguments support the hypothesis that index futures trading increases liquidity in the underlying cash market. The empirical work in the literature has focused on the effects on volatility of index futures trading. In many cases (Grossman, 1988b; Edwards 1988; Bessembinder and Seguin, 1992) higher liquidity associated with lower volatility was found to result from index futures trading.

The first set of regression tests used the volume of trade in the constituents of the indices as a measure of the liquidity of the underlying assets. The results indicate significant relationships with both the volume and value of related futures trading for all three indices. There is a significant positive relationship between the level of futures trading activity and the liquidity of the cash market.

The second set of regression tests used the liquidity ratio as a measure of the liquidity of the underlying assets. The results did not indicate any significant relationships between the liquidity of the underlying assets and the level of futures trading.

These conflicting results highlight the problem associated with the measurement of liquidity. An increase in volume, all else being equal, does however improve the tradability and thus the liquidity of an asset (De Villiers, 1992). The results therefore support the hypothesis that index futures trading is associated with greater liquidity in the underlying assets.

6.4 Scope for further research

The measurement of liquidity is identified as being problematic. Further research into establishing suitable measures of the tradability of assets is required. The results of such research may open the way to more investigation of ways to improve liquidity.

Further research of the relationship between the JSE and the SAFEX would be useful. Short-run versus long-run volatility tests and their relationship with SAFEX trading levels could improve our understanding of the link between the two markets. At present a lack of availability of intra-day data on both markets imposes restrictions on this research.

The introduction of commodity futures trading on the SAFEX has opened opportunities for further research into the effects on the underlying assets.

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